

Hazard Profile – Flood

Introduction^{1, 2, 3, 4}

Floods cause loss of life and damage to structures, crops, land, flood control structures, roads, and utilities. Floods also cause erosion and landslides, and can transport debris and toxic products that cause secondary damage. Flood damage in Washington State exceeds damage by all other natural hazards.

There have been 28 Presidential Major Disaster Declarations for floods in Washington State from 1956 through October 2003. Every county has received a Presidential Disaster Declaration for flooding since 1970. While not every flood creates enough damage to merit such a declaration, most are severe enough to warrant intervention by local, state or federal authorities.

Since 1980, federal, state and local governments have invested more than \$522 million to repair public facilities, help individuals recover from flood disasters, and pay for measures to prevent future flood damage. This is nearly 40 percent of the more than \$1.37 billion amount spent on disaster relief and hazard mitigation during this time

The magnitude of most floods in Washington depend on the particular combinations of intensity and duration of rainfall, pre-existing soil conditions (i.e., was the ground wet or frozen before the storm), area of a basin, elevation of the rain or snow level, and amount of snow pack. Man-made changes to a basin also can affect the size of floods.

Although floods can happen at any time during the year, there are typical seasonal patterns for flooding in Washington State, based on the variety of natural processes that cause floods:

- Heavy rainfall on wet or frozen ground, before a snow pack has accumulated, typically cause fall and early winter floods.
- Rainfall combined with melting of the low-elevation snow pack typically cause winter and early spring floods.
- Late spring floods in Eastern Washington result primarily from melting of the snow pack.
- Thunderstorms typically cause flash flood during the summer in Eastern Washington; on rare occasions, thunderstorms embedded in winter-like rainstorms cause flash floods in Western Washington.

Many rivers in Western Washington typically flood every two to five years; damaging flood events occur less frequently. These include rivers flowing off the west slopes of the Cascade Mountains (Cowlitz, Green, Cedar, Snoqualmie, Skykomish, Snohomish, Stillaguamish, Skagit, Nisqually, Puyallup, Lewis, and Nooksack), out of the Olympic Mountains (Satsop, Elwha, and Skokomish), and out of the hills of southwest Washington (Chehalis, Naselle, Dungeness, and Willapa). Long periods of rainfall and mild temperatures are normally the cause.

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Several rivers in Eastern Washington also flood every two to five years, including the Spokane, Okanogan, Methow, Yakima, Walla Walla, and Klickitat; again, damaging events occur less frequently. Flooding on rivers east of the Cascades usually results from periods of heavy rainfall on wet or frozen ground, mild temperatures, and from the spring runoff of mountain snow pack.

Eastern Washington is prone to flash flooding. Thunderstorms, combined with steep ravines, alluvial fans, dry or frozen ground, and lightly vegetated ground that does not absorb water, can cause flooding.

All of the Pacific coastal counties, Puget Sound and Strait of Juan de Fuca coastal counties, and counties at the mouth of the Columbia River, are susceptible to wind and barometric tidal flooding

Occasionally, communities experience surface water flooding due to high groundwater tables or inadequate urban storm drainage. This occurred during the 1996-97 winter storms. In many communities, residents outside the flood plain had several inches of water in basements due to groundwater seepage. These floods contaminated domestic water supplies, fouled septic systems, and inundated electrical and heating systems. Fire-fighting access was restricted, leaving homes vulnerable to fire. Lake levels were the highest in recent history, and virtually every county had areas of ponding not previously seen.

Floodplains make up about 2.5 percent of the state's total land area. These areas contain an estimated 100,000 households. All the homes and people who live in them are vulnerable to flood damage. Only about 20 to 30 percent of the homes in floodplains have insurance for flood losses. Uninsured homeowners face greater financial liability than they realize. During a typical 30-year mortgage period, a home in a mapped floodplain has 26 percent chance of damage by a 100-year flood event. The same structure only has about a 1 percent chance of damage by fire.

Development in or near floodplains increases the likelihood of flood damage in two ways. First, new developments near a flood plain add structures and people in flood areas. Secondly, new construction alters surface water flows by diverting water to new courses or increases the amount of water that runs off impervious pavement and roof surfaces. This second effect diverts waters to places previously safe from flooding.

Significant Floods in Washington State – 1948 to 2003

The following is a synopsis of damaging floods that occurred in this half-century. It is not a complete history of flood events, but a sample for which documentation is readily available that shows the breadth of the flood problem in Washington.

Several flood disasters described below include narratives or tables that depict projected recurrence rates for floods of the magnitude observed; information is for events and selected rivers, streams and lakes for which data is available. The

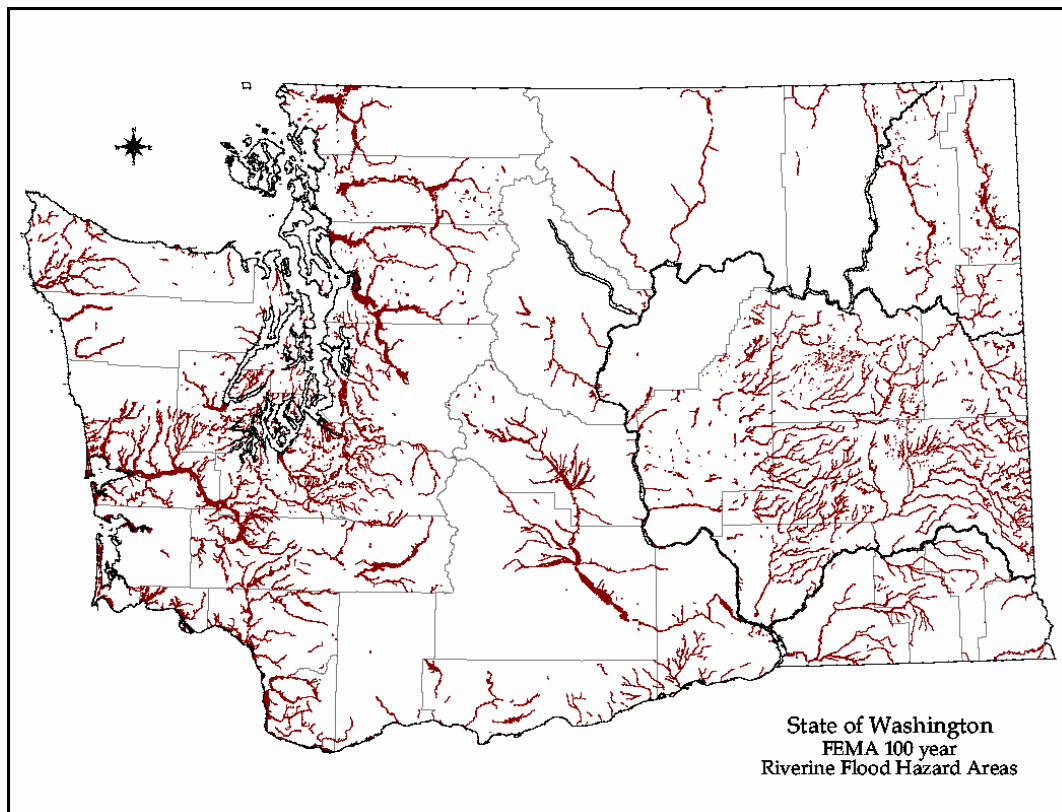
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probability of a flood event occurring is expressed as a percent chance that a flood of a specific magnitude will occur in any given year. For example, a flood with a 10-year recurrence rate has a 10 percent chance of occurring in any one year.

The table below shows how recurrence rate translates to the chance of occurrence for the types of floods the state has experienced.

Flood Return Intervals	Chance of Occurrence In Any Given Year
10 Years	10%
20 Years	5%
25 Years	4%
50 Years	2%
100 Years	1%
500 Years	0.2%

For some tables below, recurrence intervals determined using data in *Magnitude and Frequency of Floods in Washington*, Department of Interior, United States Geological Survey Water-Resources Investigations Report 97-4277, 1998.



Source: Department of Ecology, Floodplain Management Program

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*May-June 1948*⁵

Vanport Flood. One of the top 10 weather events in Washington during the 20th Century, according to National Weather Service, Seattle Forecast Office.

Snowmelt flooding broke lake and river records in Eastern Washington and along the Columbia River to the Pacific Ocean. The Columbia River below Priest Rapids, WA, established a new flood of record at 458.65 feet (flood stage 432.0 feet). The Methow River at Pateros WA, established a new flood of record at 12.30 feet (flood stage 10.0 feet). The flood lasted 45 days.

Vancouver, Camas, Kalama, and Longview suffered flood damage. Most notable for wiping out the community of Vanport in North Portland in less than one hour as dikes along the Columbia River gave way. Vanport, America's largest wartime housing project, was not rebuilt.

Recurrence interval of this Columbia River flood projected at 30 years.⁶ A number of hydroelectric dams constructed on the Columbia after this event also control flooding, reducing the probability of flooding along much of the length of the river in Washington.

May-June 1972

Federal Disaster #334.

Snow melt in north-central Washington counties of Chelan, Douglas, and Okanogan, combined with heavy rains, produced major flooding on the Okanogan and Methow Rivers in Okanogan County and the Entiat River in Chelan County. All three rivers reached record flood stages.

Recurrence intervals for flood levels are not available for this disaster.

*December 1982*⁷

Federal Disaster #676. Disaster assistance provided – \$1.7 million. Small Business Administration loaned \$1 million to home and business owners for damages.

Flooding, severe storm, and high tide affected Whatcom County. Four persons injured, 122 people evacuated; 129 homes and 113 businesses damaged; \$1.7 million in public facility damage.

Recurrence intervals for flood levels are not available for this disaster.

*January 1986*⁸

Federal Disaster #757.

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Flooding and severe storms in Clallam, Jefferson, and King Counties, caused \$5 million in damage to public facilities.

Recurrence intervals for flood levels are not available for this disaster.

*February 1986*⁹

Federal Disaster #762.

Flooding, heavy rainfall, and mudslides in Cowlitz County caused \$5 million in damage to public facilities and private property.

Recurrence interval of the Cowlitz River flood at Castle Rock projected at 2 years.

*November 1986*¹⁰

Federal Disaster #784. Disaster assistance provided – \$1.9 million.

Heavy rainfall, mild temperatures, and low-elevation snowmelt generated major floods on the Chehalis, Skookumchuck, Skykomish, Snoqualmie, and Snohomish Rivers. Less severe flooding occurred on the Satsop, Skokomish, Cedar, Stillaguamish, Skagit, and Nooksack Rivers. Flooding occurred in Cowlitz, King, Lewis, Pacific, Snohomish, and Wahkiakum Counties.

Two deaths; \$11 million in private property damage and \$6 million in public facility damage.

One-hundred twenty homes in the City of Snoqualmie evacuated. Two-hundred eighty homes and businesses flooded in Lewis County; impacts included a hazardous materials spill from an underground chemical tank and Lewis County fairgrounds under nine feet of water.

Numerous levies overtopped and damaged throughout flooded counties.

Disaster #784, Flood Recurrence Interval This Event, Selected Rivers

River (County)	Flood Recurrence Interval	Chance of Annual Occurrence
Snoqualmie (King County)	15 – 20 Years	4 – 6%
Skykomish (Snohomish County)	10 – 25 Years	4 – 10%
Snohomish (Snohomish County)	5 – 15 Years	6 – 20%
Puyallup (Pierce County)	40 – 45 Years	~2%
Chehalis (Grays Harbor County)	45 – 50 Years	~2%

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*March 1989*¹¹

Federal Disaster #822. Stafford Act disaster assistance provided – \$3.8 million.

Flooding and heavy rainfall affected Douglas, Okanogan, Stevens, and Whitman Counties. Roads and utilities heavily damaged in four rural counties. Mud from flooding impaired the city of Bridgeport's sewage treatment facility for months.

Two million dollars in damage to public facilities.

Recurrence intervals for flood levels are not available for this disaster.

*January 1990*¹²

Federal Disaster #852. Stafford Act disaster assistance provided – \$17.8 million.

Flooding occurred on the Chehalis, Skookumchuck, and Deschutes Rivers as heavy rainfall and severe storms affected Benton, Grays Harbor, King, Lewis, Pierce, Thurston, and Wahkiakum Counties.

Four deaths; \$16 million in damages to public facilities and \$6 million private property damage.

Hundreds of people evacuated, several hundred homes and businesses damaged or destroyed. Chehalis hospital isolated by floodwaters; several nursing homes evacuated. Interstate 5 in Chehalis closed for several days, covered by 3 to 5 feet of water.

Recurrence intervals for flood levels are not available for this disaster.

November 1990^{13, 14}

Federal Disaster #883. Stafford Act disaster assistance provided – \$57 million.

One of the top 10 weather events in Washington during the 20th Century, according to National Weather Service, Seattle Forecast Office.

Severe storms and flooding occurred during Veteran's Day and Thanksgiving weekend holidays in Chelan, Clallam, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Lewis, Mason, Pacific, Pierce, San Juan, Skagit, Snohomish, Thurston, Wahkiakum, Whatcom, and Yakima counties.

Widespread, major flooding occurred in both Western and Eastern Washington. Rivers with major flooding were the Skagit and Nooksack Rivers. The Thanksgiving weekend floods set record flood stages on the Naselle, Willapa, Hoh, Calawah, Dungeness,

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Skokomish, Cedar, Skykomish, Snoqualmie, Snohomish, Stillaguamish, Chiwawa, Wenatchee, Elwha, and Klickitat Rivers.

Two people died; more than 500 cattle perished. Damage estimated at \$250 million.

Many levies overtopped and damaged. Hundreds of homes evacuated; much of the city of Snoqualmie evacuated.

Thousands of acres of farmland flooded and evacuated; on Fir Island, Skagit County, 167 homes were flooded by 8 feet of water; on Eby Island, Snohomish County, only people with elevated homes stayed.

Disaster #883, Flood Recurrence Interval This Event, Selected Rivers

River (County)	Flood Recurrence Interval	Chance of Annual Occurrence
Skagit (Skagit County)	50 Years	2%
Snohomish (Snohomish County)	50 – 100 Years	1 – 2%
Nooksack (Whatcom County)	100 Years	1%

December 1990

Federal Disaster #896. Stafford Act disaster assistance provided – \$5.1 million.

Floods, storms, and high winds affected the counties of Island, Jefferson, King, Kitsap, Lewis, Pierce, San Juan, Skagit, Snohomish, and Whatcom.

Recurrence intervals for flood levels are not available for this disaster.

*November – December 1995*¹⁵

Federal Disaster #1079. Stafford Act disaster assistance provided – \$45.9 million. Small Business Administration disaster loans approved - \$4.3 million.

Flooding and wind in the counties of Chelan, Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, King, Kittitas, Lewis, Mason, Pacific, Pierce, Skagit, Snohomish, Thurston, Wahkiakum, Whatcom, and Yakima.

More than 850 homes damaged or destroyed; one death reported.

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Disaster #1079, Flood Recurrence Interval This Event, Selected Rivers¹⁶

River (County)	Flood Recurrence Interval	Chance of Annual Occurrence
Naselle near Naselle (Pacific County)	10 Years	10%
Quinault at Quinault Lake (Grays Harbor County)	10 Years	10%
American River near Nile (Yakima County)	10 Years	10%
Snoqualmie, multiple locations (King County)	10 – 25 Years	4 – 10%
Willapa near Willapa (Pacific County)	15 Years	7%
Snohomish (Snohomish County)	20 Years	5%
Cedar, multiple locations (King County)	20 – 40 Years	~2 – 5%
Nooksack near Ferndale (Whatcom County)	25 Years	4%
Sauk near Sauk (Skagit County)	25 Years	4%
Skagit, multiple locations (Skagit County)	50 – 75 Years	~2%
Cowlitz, multiple locations (Cowlitz County)	50 – 100 Years	1 – 2%
Nisqually at LaGrande (Thurston County)	50 Years	2%
Puyallup at Alderton (Pierce County)	100 Years	1%
Stehekin at Stehekin (Chelan County)	100 Years	1%
Wenatchee, multiple locations (Chelan County)	100 Years	1%

February 1996^{17, 18}

Federal Disaster #1100. Stafford Act disaster assistance provided – \$113 million.
Small Business Administration disaster loans approved - \$61.2 million.

One of the top 10 weather events in Washington during the 20th Century, according to National Weather Service, Seattle Forecast Office.

Heavy rainfall, mild temperatures and low-elevation snowmelt caused flooding in Adams, Asotin, Benton, Clark, Columbia, Cowlitz, Garfield, Grays Harbor, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Pierce, Skagit, Skamania, Snohomish, Spokane, Thurston, Wahkiakum, Walla Walla, Whitman and Yakima counties, and the Yakima Indian Reservation.

Record floods occurred on the Columbia, Snoqualmie, Cedar, Chehalis, Nisqually, Skookumchuck, Klickitat, Skokomish, Cowlitz, Yakima, Naches, Palouse and Walla Walla Rivers, and Latah Creek. The table below shows how frequently flooding of the magnitude observed in this event will occur on selected rivers and streams for which data is available.

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Disaster #1100, Flood Recurrence Interval This Event, Selected Rivers and Streams¹⁹

River / Stream (County)	Flood Recurrence Interval	Chance of Annual Occurrence
Ahtanum Creek (Yakima County)	20 Years	5%
Deschutes River (Thurston County)	25 Years	4%
South Prairie Creek (Pierce County)	37 Years	3%
Newaukum River (Lewis County)	90 Years	~1%
Chehalis River (Thurston, Lewis Counties)	90 – 100 Years	1%
Newaukum Creek (King County)	100 Years	1%
Puyallup River (Pierce County)	100 Years	1%

Mudslides occurred throughout the state.

Three deaths, 10 people injured. Nearly 8,000 homes damaged or destroyed. Traffic shut down for several days both east and west, and north and south, along major state highways. Snow avalanches closed Interstate 90 at Snoqualmie Pass. Mudslides in Cowlitz County and flooding in Lewis County closed Interstate 5. Damage throughout the Pacific Northwest estimated at \$800 million.

December 1996 - January 1997²⁰

Federal Disaster #1159. Stafford Act disaster assistance provided – \$83 million. Small Business Administration loans approved – \$31.7 million.

Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a five-day period to cause flooding.

Impacted counties – Adams, Asotin, Benton, Chelan, Clallam, Clark, Columbia, Cowlitz, Douglas, Ferry, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Mason, Okanogan, Pacific, Pend Oreille, Pierce, San Juan, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Walla Walla, Whatcom, Whitman, and Yakima.

Significant urban flooding occurred north of Pierce County; significant river flooding occurred south of Pierce County; severe groundwater flooding took place in Pierce and Thurston Counties. The table below shows how frequently flooding of the magnitude observed in this event will occur on selected rivers and lakes for which data is available.

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Disaster #1159, Flood Recurrence Interval, Selected Rivers and Lakes²¹

River / Lake (County)	Flood Recurrence Interval	Chance of Annual Occurrence
Chehalis River (Grays Harbor County)	10 Years	10%
Klickitat River (Klickitat County)	10 Years	10%
Palouse River (Whitman County)	10 Years	10%
Skookumchuck River (Lewis County)	10 Years	10%
White Salmon River (Skamania County)	10 Years	10%
Black Lake (Thurston County)	40 Years (lake elevation)	~2%
Scott Lake (Thurston County)	40 Years (lake elevation)	~2%
Deschutes River (Thurston County)	45 Years	~2%
Lake Sammamish (King County)	70 Years (lake elevation)	~1.5%
Newaukum River (Lewis County)	100 Years	1%

Twenty-four deaths; \$140 million (est.) in insured losses; 250,000 people lost power.

More than 130 landslides occurred between Seattle and Everett, primarily along shorelines. Interstate 90 at Snoqualmie pass closed due to avalanche.

March 1997

Federal Disaster #1172. Stafford Act disaster assistance provided – \$6.5 million. Small Business Administration disaster loans approved – \$2.9 million

Heavy rainfall and low-elevation mountain snowmelt caused flooding in counties of Grays Harbor, Jefferson, King, Kitsap, Lincoln, Mason, Pacific, Pierce, Pend Oreille, and Stevens. The table below shows how frequently flooding of the magnitude observed in this event will occur on selected rivers for which data is available.

Disaster #1172, Projected Flood Recurrence Interval This Event, Selected Rivers

River (County)	Flood Recurrence Interval	Chance of Annual Occurrence
Naselle River (Pacific County)	100 Years	1%
Satsop River (Grays Harbor County)	200 Years	1%
Wynoochee River (Grays Harbor County)	200 Years	0.5%

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May 1998

Federal Disaster #1252. Stafford Act disaster assistance provided – \$3.6 million.

Heavy rainfall caused flooding in Ferry and Stevens Counties.

Recurrence intervals for flood levels are not available for this disaster.

October 2003²²

Federal Disaster #1499. Stafford Act disaster assistance provided to date – \$ _____ million. Small Business Administration disaster loans approved – \$ _____ million. *(Information to come)*

Heavy rainfall caused severe flooding in Chelan, Clallam, Grays Harbor, Island, Jefferson, King, Kitsap, Mason, Okanogan, Pierce, San Juan, Skagit, Snohomish, Thurston and Whatcom counties. Most severe flooding took place along the Skagit River. Record flood levels were set on the Skagit River at Concrete, Sauk River, and Stehekin River.

More than 3,400 people were evacuated. Thirty-three homes were destroyed, 112 homes had major damage, with property damage estimated at \$30 million. Numerous federal, state and county roads were damaged by landslides and floodwaters.

Disaster #1499, Projected Flood Recurrence Interval This Event, Selected Rivers

River (County)	Flood Recurrence Interval	Chance of Annual Occurrence
Nooksack at Deming (Whatcom County)	25 Years	4%
Skagit near Mount Vernon (Skagit County)	40 Years	~2%
Sauk near Sauk (Skagit County)	100 Years	1%
Stillaguamish at Arlington (Snohomish County)	100 Years	1%
Skokomish near Potlatch (Mason County)	100 – 200 Years	0.5 – 1%
Stehekin at Stehekin (Chelan County)	100 – 200 Years	0.5 – 1%

Jurisdictions Most Vulnerable to Flooding

For the State Hazard Mitigation Plan, factors used to determine which counties are most vulnerable to future flooding are:

- Frequency of flooding that causes major damage, based on the number of Presidential Disaster Declarations in the past half century as an indicator

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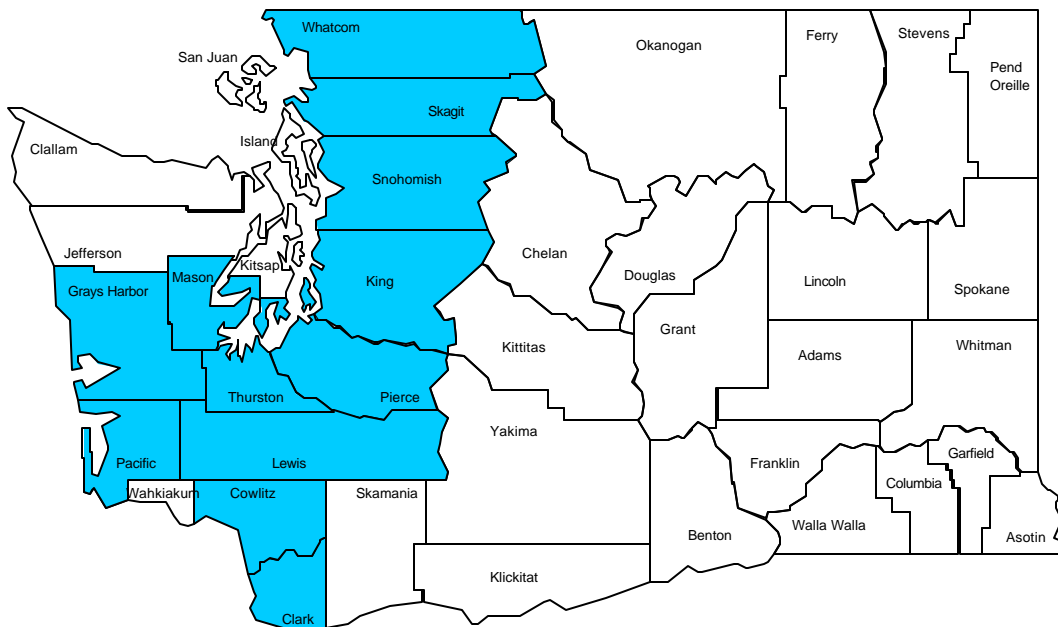
(recurring every seven years or less) – a measure of how often serious, damaging flood events occur.

- Percentage of the County in Floodplain (2 percent or more of the area of the county) – a measure of the size of the area within a county at-risk to flooding.
- Number of Flood Insurance Policies Currently in Effect (top 19 counties) – a measure of the built environment in the floodplain.
- Number of Flood Insurance Claims Paid Since 1978 (top 24 counties) – another measure of the built environment in the floodplain.

Based on these factors (see table, page 17), the following counties are at greatest risk and most vulnerable to flooding:

Clark	Cowlitz	Grays Harbor	King
Lewis	Mason	Pacific	Pierce
Skagit	Snohomish	Thurston	Whatcom

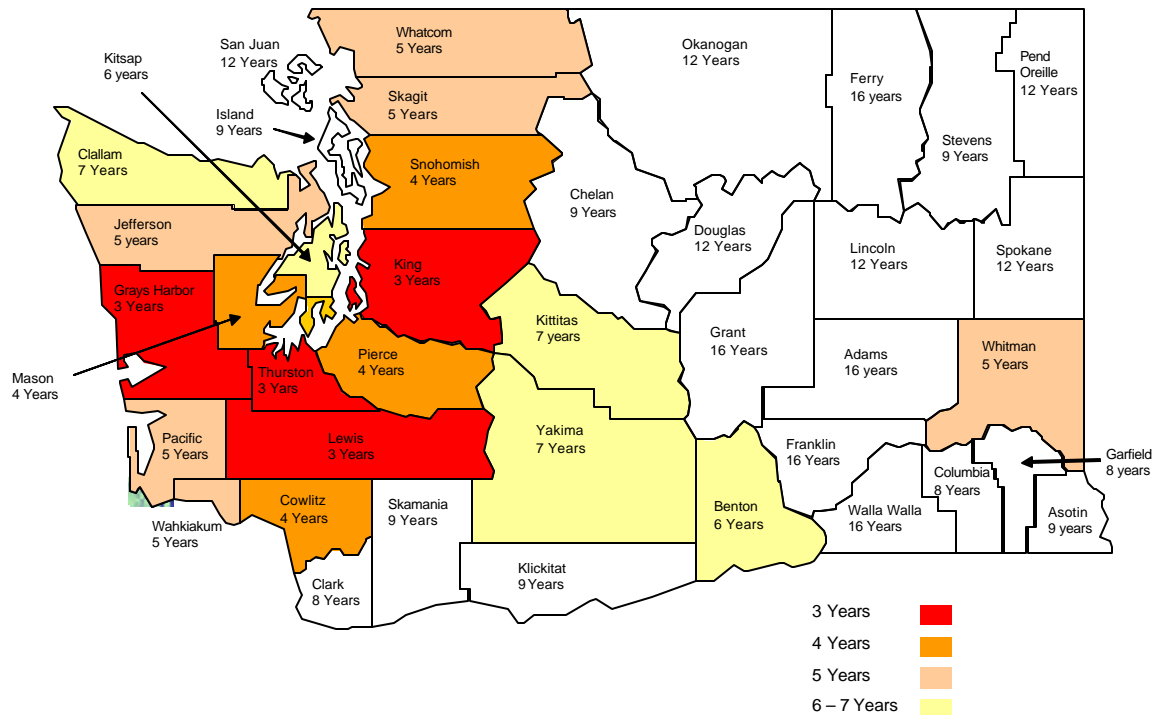
Counties Most At-Risk and Vulnerable to Flood



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Frequency of Major Flood Occurrence

Frequency of Major Flood Occurrence, 1956 to Present



Frequency of Flooding Causing Major Damage, Since 1956

Grays Harbor	3 Yrs.	Skagit	5 Yrs.
King	3 Yrs.	Wahkiakum	5 Yrs.
Lewis	3 Yrs.	Whatcom	5 Yrs.
Thurston	3 Yrs.	Whitman	5 Yrs.
Cowlitz	4 Yrs.	Benton	6 Yrs.
Mason	4 Yrs.	Kitsap	6 Yrs.
Pierce	4 Yrs.	Clallam	7 Yrs.
Snohomish	4 Yrs.	Kittitas	7 Yrs.
Jefferson	5 Yrs.	Yakima	7 Yrs.
Pacific	5 Yrs.		

Presidential Disaster Declarations provide a good indicator of major damage caused by a hazard event. There have been 28 Presidential Disaster Declarations for flooding since 1956. Each county has received at least one disaster declaration for flooding since 1970.²³

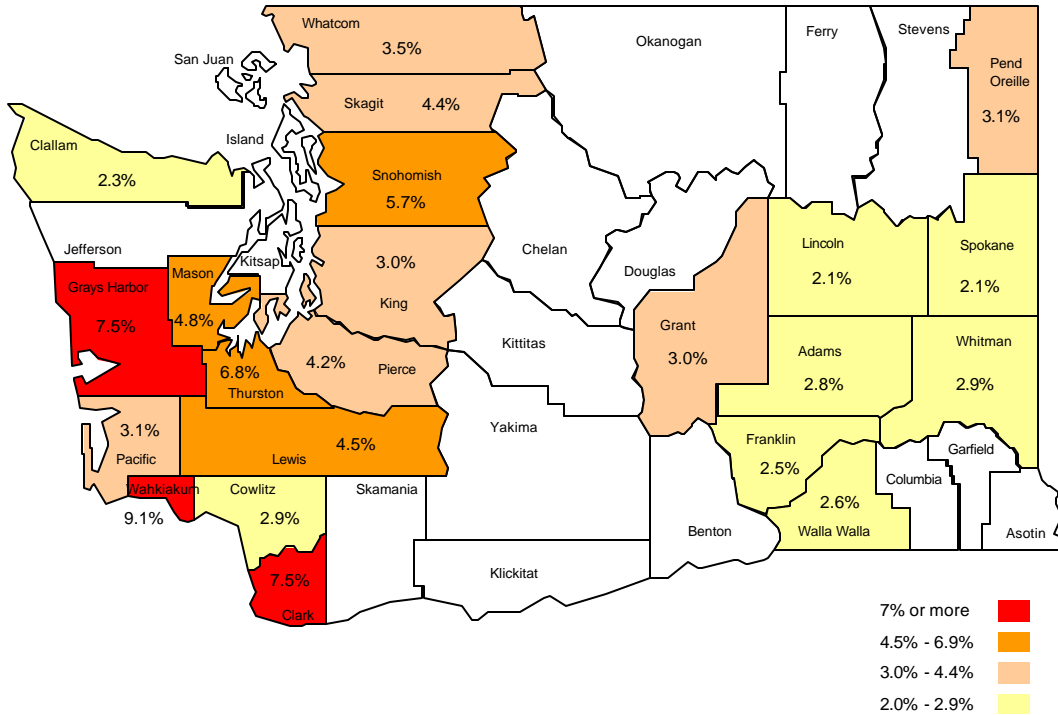
The counties in the table to the left are those that have experienced the most frequent flooding resulting in major damages and a Presidential Disaster Declaration.

Occurrence rates are approximate, and rounded to the nearest year.

Hazard Profile – Flood

Percentage of County in Floodplain

Counties with 2 Percent or More of Land Area in Floodplain



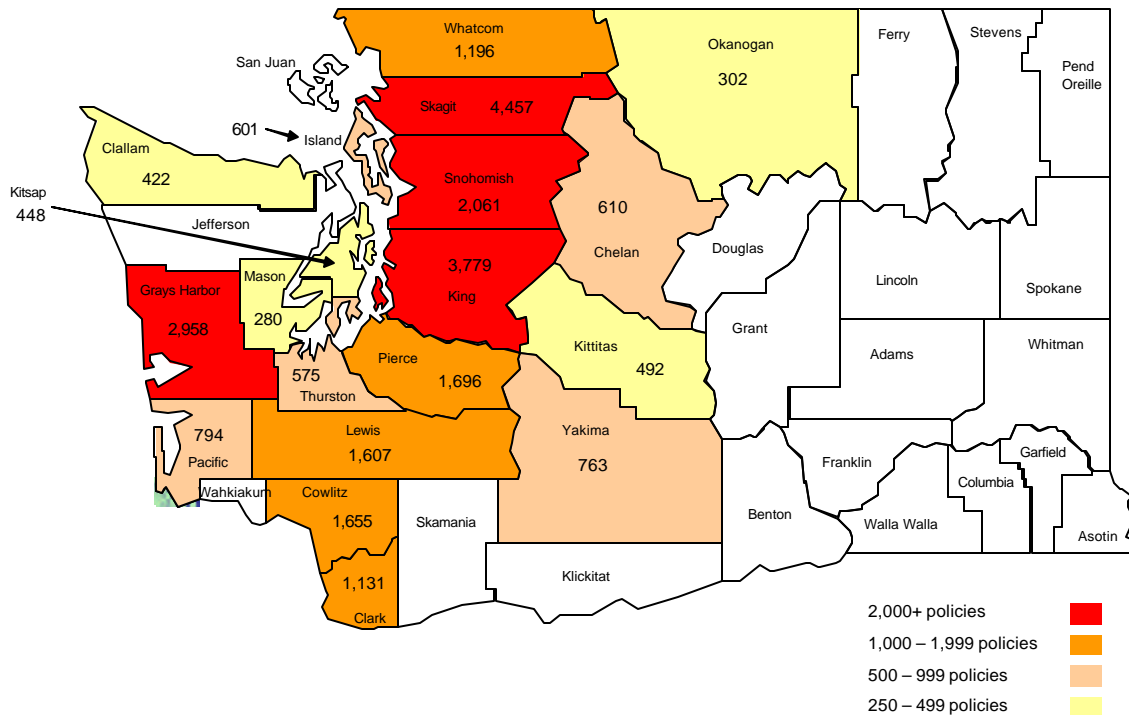
County	% Floodplain	County	% Floodplain
Wahkiakum	9.1%	Pend Oreille	3.1%
Clark	7.5%	King	3.0%
Grays Harbor	7.5%	Grant	3.0%
Thurston	6.8%	Cowlitz	2.9%
Snohomish	5.7%	Whitman	2.9%
Mason	4.8%	Adams	2.8%
Lewis	4.5%	Walla Walla	2.6%
Skagit	4.4%	Franklin	2.5%
Pierce	4.2%	Clallam	2.3%
Whatcom	3.5%	Lincoln	2.1%
Pacific	3.1%	Spokane	2.1%

Twenty-two counties have 2 percent or more of their area in floodplain.²⁴

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Flood Insurance Policies in Place

19 Counties With Largest Number of Flood Insurance Policies In Place, 2003



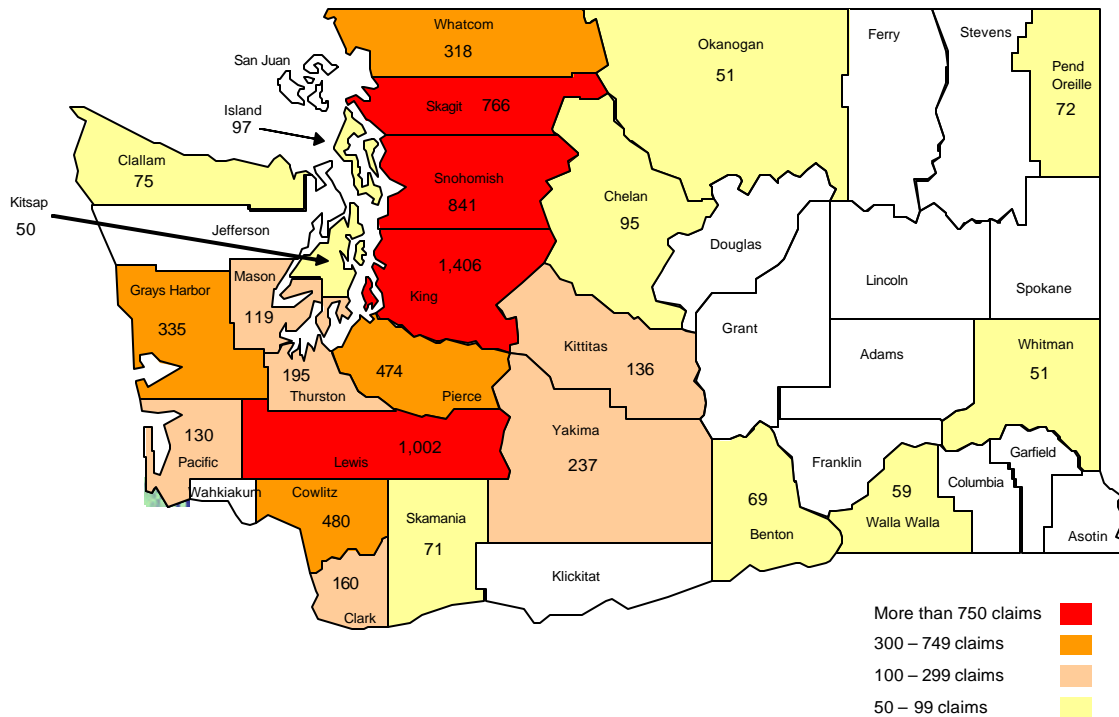
County	# Policies	County	# Policies
Skagit	4457	Yakima	763
King	3779	Chelan	610
Grays Harbor	2958	Island	601
Snohomish	2061	Thurston	575
Pierce	1696	Kittitas	492
Cowlitz	1655	Kitsap	448
Lewis	1607	Clallam	422
Whatcom	1196	Okanogan	302
Clark	1131	Mason	280
Pacific	794		
State total		27421	

Nineteen counties with the largest number of flood insurance policies currently in force; number includes their cities, towns and unincorporated area.²⁵

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Flood Insurance Claims

24 Counties With Most Flood Insurance Claims Since 1978



County	# Claims	County	# Claims
King	1406	Pacific	130
Lewis	1002	Mason	119
Snohomish	841	Island	97
Skagit	766	Chelan	95
Cowlitz	480	Clallam	75
Pierce	474	Pend Oreille	72
Grays Harbor	335	Skamania	71
Whatcom	318	Benton	69
Yakima	237	Walla Walla	59
Thurston	195	Okanogan	51
Clark	160	Whitman	51
Kittitas	136		
State total		7422	

Top 24 counties with most flood insurance claims since 1978; number includes their cities, towns and unincorporated area.²⁶

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Jurisdictions Most Vulnerable to Flood

County	Approx. Frequency of Occurrence	% Area in Floodplain	# Flood Insurance Policies	# Flood Insurance Claims	Score
Grays Harbor	3 Yrs.	7.5%	2958	335	15
King	3 Yrs.	3.0%	3779	1406	14
Lewis	3 Yrs.	4.5%	1607	1102	14
Snohomish	4 Yrs.	5.7%	2061	841	14
Skagit	5 Yrs.	4.4%	4457	766	13
Pierce	4 Yrs.	4.2%	1696	474	12
Thurston	3 Yrs.	6.8%	575	195	12
Cowlitz	4 Yrs.	2.9%	1655	480	10
Whatcom	5 Yrs.	3.5%	1196	318	10
Clark	8 Yrs.	7.5%	1131	160	9
Mason	4 Yrs.	4.8%	280	119	9
Pacific	5 Yrs.	3.1%	794	130	8

Legend

Counties most vulnerable to flood are in BOLD type in column above.	3 Yrs.	6.5% or More	> 2,000	> 750	4 points each
	4 Yrs.	4.0 – 6.4%	1,000 – 1,999	300 – 749	3 points each
	5 Yrs.	3.0 – 3.9%	500 – 999	100 – 299	2 points each
	6 – 7 Yrs.	2.0 – 2.9%	250 – 499	50 – 99	1 point each

Note: Counties identified on previous pages as being one of the top jurisdictions in one or more of the identified factors that received less than eight points are excluded from the table above.

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State Agency Structures At Risk		PRELIMINARY ASSESSMENT	
Number and Function of Buildings	No. of Affected Staff / Visitors / Residents	Approx. Value of Structures	Approx. Value of Contents All Structures
<u>Total at-risk buildings:</u> State agencies participating in this plan identified 455 facilities as being potentially at-risk to direct damage or to the indirect impacts of flooding (utility services reductions, transportation restrictions, etc.).		21,579	\$526,798,900
<u>Function of at-risk buildings:</u> Included in the state facilities potentially at-risk to the impacts of flooding are the following: <ul style="list-style-type: none"> • Campuses of Naselle Youth Camp, Maple Lane School, and Green Hill School for juvenile offenders. • Campuses of Fircrest School and Rainier School for mentally disabled adults. • Campus of Big Bend Community College. • About 100 general and client services offices that include those serving individuals and families on public assistance, providing employment and training services, driver licensing, and liquor sales. 		\$450,640,732	

More detailed narratives on at-risk facilities are in Region profiles, Tab 7.2.1 – Tab 7.2.9.

Eighteen state highways considered emphasis corridors because of their importance to movement of people and freight are potentially at risk to flooding because all of them have segments that traverse or cross floodplain:

1. Interstate 5	2. Interstate 82	3. Interstate 90
4. Interstate 405	5. U.S. Highway 2	6. U.S. Highway 8
7. U.S. Highway 12	8. U.S. Highway 20	9. U.S. Highway 95
10. U.S. Highway 97	11. U.S. Highway 101	12. U.S. Highway 195
13. U.S. Highway 395	14. State Route 14	15. State Route 16
16. State Route 18	17. State Route 20	18. State Route 167

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<u>Total at-risk critical facilities:</u> State agencies participating in this plan identified 192 critical facilities as being potentially at-risk to direct damage or to the indirect impacts of flooding (utility services reductions, transportation restrictions, etc.).	9,085	\$217,804,568	\$231,620,773
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Function of at-risk critical facilities: Included in the state facilities potentially at-risk to the impacts of flooding are the following:

- Buildings on the campuses of Maple Lane School and Green Hill School for juvenile offenders.
- Buildings on the campuses of Fircrest School and Rainier School for mentally disabled adults.
- Campus of Big Bend Community College.
- About 70 general office and client services offices that include those serving individuals and families on public assistance, providing employment and training services, driver licensing, and liquor sales.

Eighteen state highways considered emphasis corridors because of their importance to movement of people and freight are potentially at risk to flooding because all of them have segments that traverse or cross floodplain:

1. Interstate 5	2. Interstate 82	3. Interstate 90
4. Interstate 405	5. U.S. Highway 2	6. U.S. Highway 8
7. U.S. Highway 12	8. U.S. Highway 20	9. U.S. Highway 95
10. U.S. Highway 97	11. U.S. Highway 101	12. U.S. Highway 195
13. U.S. Highway 395	14. State Route 14	15. State Route 16
16. State Route 18	17. State Route 20	18. State Route 167

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¹ *Washington State 2001 Hazard Identification and Vulnerability Assessment*, Washington State Military Department, Emergency Management Division, April 2001.

² The totals come from the following sources: Stafford Act disaster assistance costs for disaster from 1980 through 2001 come from a spreadsheet maintained by State Hazard Mitigation Officer for assistance programs managed by Washington Military Department, Emergency Management Division, (February 20, 2003). Small Business Administration loan figures come from a spreadsheet covering disaster assistance loans provided by the U.S. Small Business Administration from 1992 through 2002, (April 28, 2003). Figures for Federal Highway Administration Emergency Relief Program assistance provided from 1980 to 2003 come from data supplied by the Washington State Department of Transportation, (March 2003). The totals do not include other disaster assistance, such as that provided by the U.S. Army Corps of Engineers to repair damages levees.

³ David Kresch and Karen Dinicola, U.S. Department of the Interior, U.S. Geological Survey, Fact Sheet 228-96, *What Causes Floods in Washington State?*, date unknown.

⁴ Ibid.

⁵ Chris Hill et al., *Top Ten 20th Century Weather Events In Washington State*, National Weather Service, Seattle Forecast Office, December 1999, <<http://www.seawfo.noaa.gov/WATOP10.htm>>, (February 20, 2003).

⁶ Richard W. Paulson et al., *National Water Summary 1988-89, Hydrologic Events and Floods and Droughts*, Washington Floods and Droughts State Summary, United States Geological Survey Water-Supply Paper 2375, 1991.

⁷ Information from *Flood Mitigation Implementation Measures Report for Whatcom County, FEMA-676-DR*, Washington State Department of Emergency Services et al., November 1983.

⁸ Information from *Flood Mitigation Strategies for Disasters 757 and 762, 1986*, Washington State Department of Community Development, Emergency Management Division, December 1, 1986.

⁹ Ibid.

¹⁰ Information from *Interagency Flood Hazard Mitigation Report, FEMA-784-DR-WA*, Region X Interagency Mitigation Team, January 1987.

¹¹ Information from *Hazard Mitigation Survey Report, FEMA-822-DR-WA*, Washington State Department of Community Development, Division of Emergency Management, 1989.

¹² Information from *Hazard Mitigation Opportunities in the State of Washington, Report of the Interagency Hazard Mitigation Team, FEMA-852-DR-WA*, Region X Interagency Hazard Mitigation Team, February 15, 1990.

¹³ Chris Hill et al., *Top Ten 20th Century Weather Events In Washington State*, National Weather Service, Seattle Forecast Office, December 1999, <<http://www.seawfo.noaa.gov/WATOP10.htm>>, (February 20, 2003)

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¹⁴ *Hazard Mitigation Opportunities in the State of Washington, Report of the Interagency Hazard Mitigation Team, FEMA-883-DR-WA*, Federal Emergency Management Agency Region X, January 1991.

¹⁵ Information from *Interagency Hazard Mitigation Team Report, with Early Implementation Strategies for DR-1079-WA and DR-1100-WA*, Federal Emergency Management Agency Region X, July 1996.

¹⁶ Information from *Maximum stages and discharges during floods of November 28-30, 1995*, United States Geological Survey, Tacoma Office, January 1996.

¹⁷ Information from Interagency Hazard Mitigation Team Report, with Early Implementation Strategies for DR-1079-WA and DR-1100-WA, Federal Emergency Management Agency Region X, July 1996.

¹⁸ Chris Hill et al., *Top Ten 20th Century Weather Events In Washington State*, National Weather Service, Seattle Forecast Office, December 1999, <<http://www.seawfo.noaa.gov/WATOP10.htm>>, (February 20, 2003).

¹⁹ Information from *Post Event Report: Winter Storm of 1996-97, Federal Disaster DR 1159, Western Washington Summary*, US Army Corps of Engineers, Seattle District, Mary 16, 1997.

²⁰ Information from Hazard Mitigation Survey Team Report for the 1996-1997 Washington Winter Storms, DR-1152-WA, DR-1159-WA, DR-1172-WA, Washington State Emergency Management Division and Federal Emergency Management Agency Region 10.

²¹ Information from *Post Event Report: Winter Storm of 1996-97, Federal Disaster DR 1159, Western Washington Summary*, US Army Corps of Engineers, Seattle District, Mary 16, 1997.

²² Rick van der Zweep, *Washington State October 2003 Flood Report*, National Oceanic and Atmospheric Administration, Northwest River Forecast Center, <http://www.mwrfc.boaa.gov/floods/oct_2003/wa_oct2003_flood.html>, (March 26, 2004).

²³ State Emergency Management Division records.

²⁴ Communication from Jerry Franklin, Washington State Department of Ecology, Floodplain Management Program, April 10, 2003.

²⁵ *National Flood Insurance Report, by State, County, Community – Washington*, Federal Emergency Management Agency Region 10, February 19, 2003.

²⁶ Ibid.